DTC and HMT collaborations

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With many contributions from HMT and DTC staff at NCAR and NOAA/ESRL (PSD and GSD)

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Motivation

- DTC and HMT (and other testbeds) share many common goals and interests
  - Accelerating transition of research to operations
  - Model testing and evaluation
  - Verification
  - Observations
- Expertise at HMT and DTC are complementary
  - Hydrometeorology; ensemble prediction
  - Testing and evaluation; verification
- Collaboration will enhance the success of both testbeds

HMT/DTC collaboration: Goals

Four areas:

1. Implementation and demonstration of verification capabilities
2. High-resolution ensemble prediction capabilities at DTC
3. Data impact studies
4. Impacts of model physics and parameterizations

HMT/DTC collaboration: Goals

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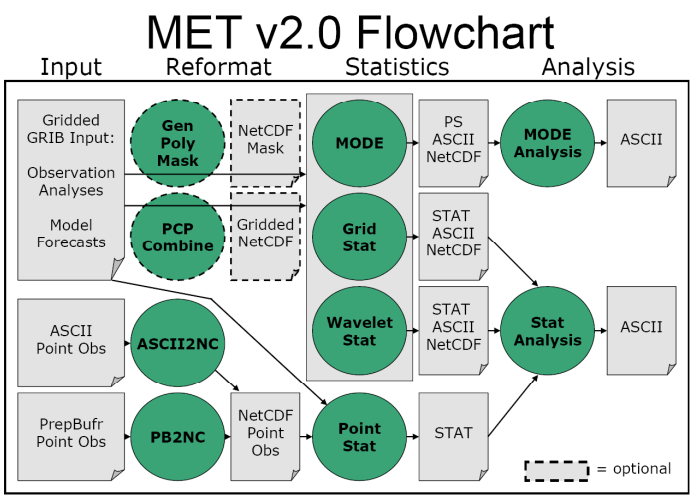
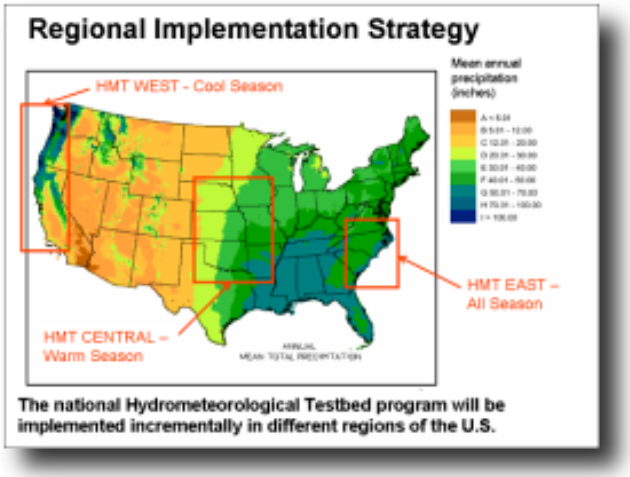
4. Impacts of model physics and parameterizations

(initial focus areas)

Area 1: Verification

- Implement current capabilities (MET and HMT)
- Extend capabilities to meet DTC and HMT needs
- Demonstration for HMT West in winter 2009-2010
- Extend capabilities to Southeast in future years

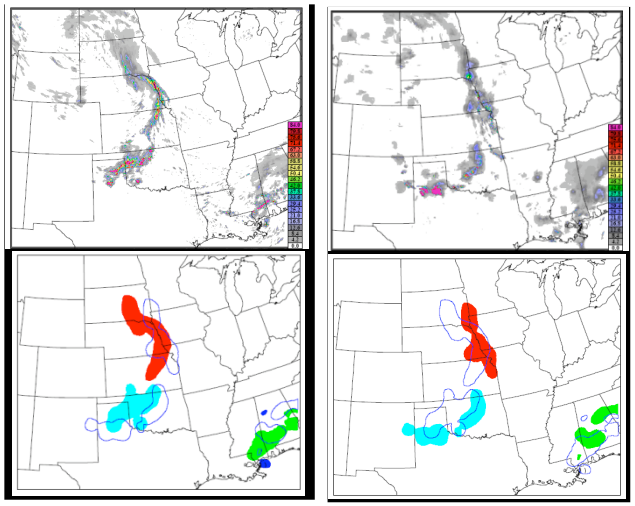


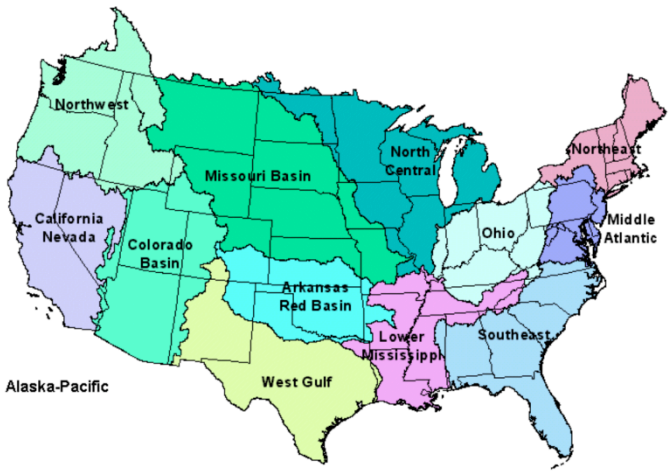


Current verification capabilities

- MET (Model Evaluation Tools)
  - Spatial methods
  - Traditional methods
- Event-based verification concepts in HMT
  - Evaluate forecasting capabilities for important (extreme) events in regions (e.g., RFCs)
- Snow-level verification in HMT

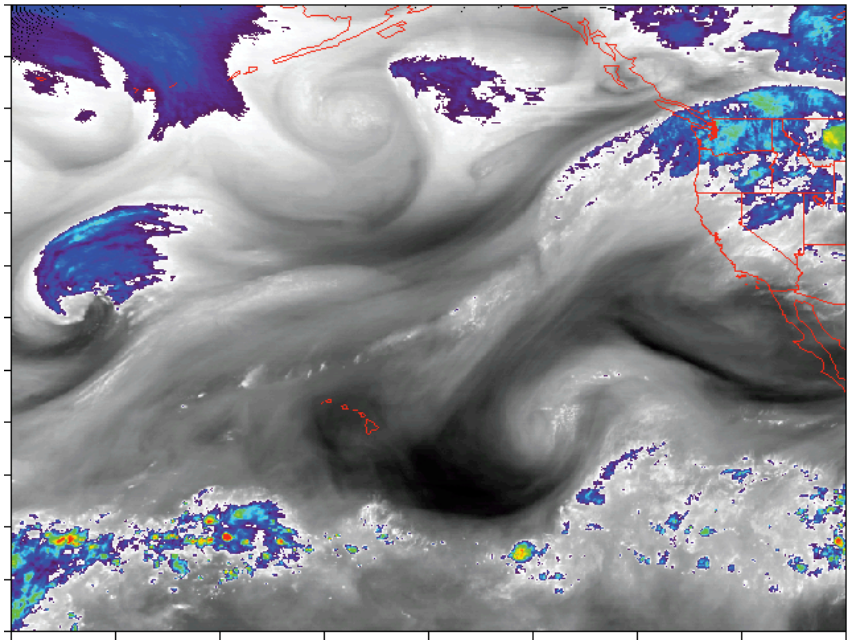
Example: MODE application





Verification needs

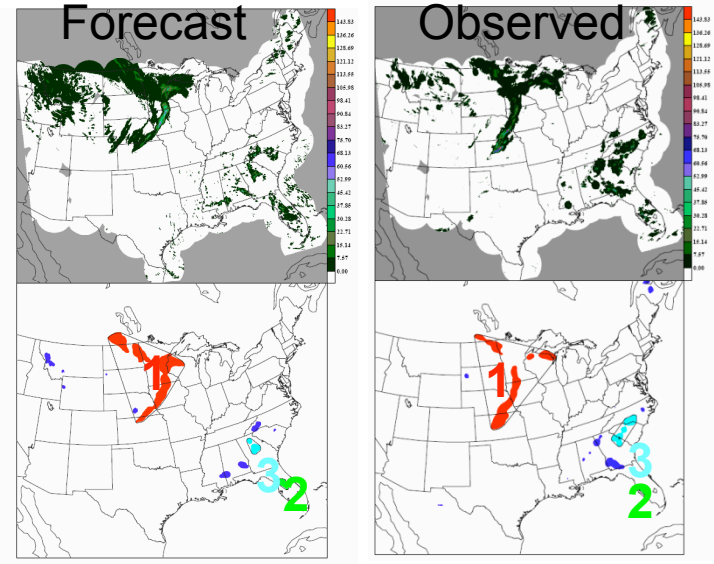
- HMT
  - Precipitation
  - Snow level
  - Atmospheric rivers
- DTC
  - Ensemble methods
  - Observation uncertainty

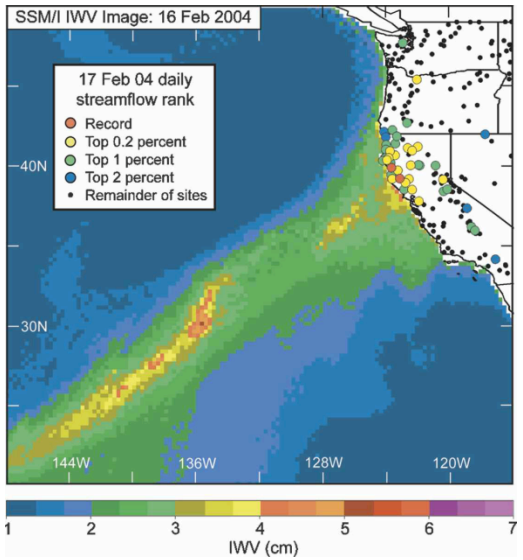


GOES 6.8 m channel (K); 06 UTC
7 Nov 06
From Neiman et al. 2008

Precipitation verification

- HMT event-based verification using traditional measures (POD, FAR, Bias, CSI)
  - Extreme events defined by region
  - MET implementation: Examine sub-regions (e.g., based on terrain or river basins)
- Application of spatial verification methods
  - Precipitation
  - Atmospheric rivers?





From Ralph et al. 2006

Ensemble verification

- Implementation of basic methods
- Efficient methods for applying MET to ensembles
- Spatial methods applied to ensembles
  - Example: MODE applied to ensembles of precipitation objects

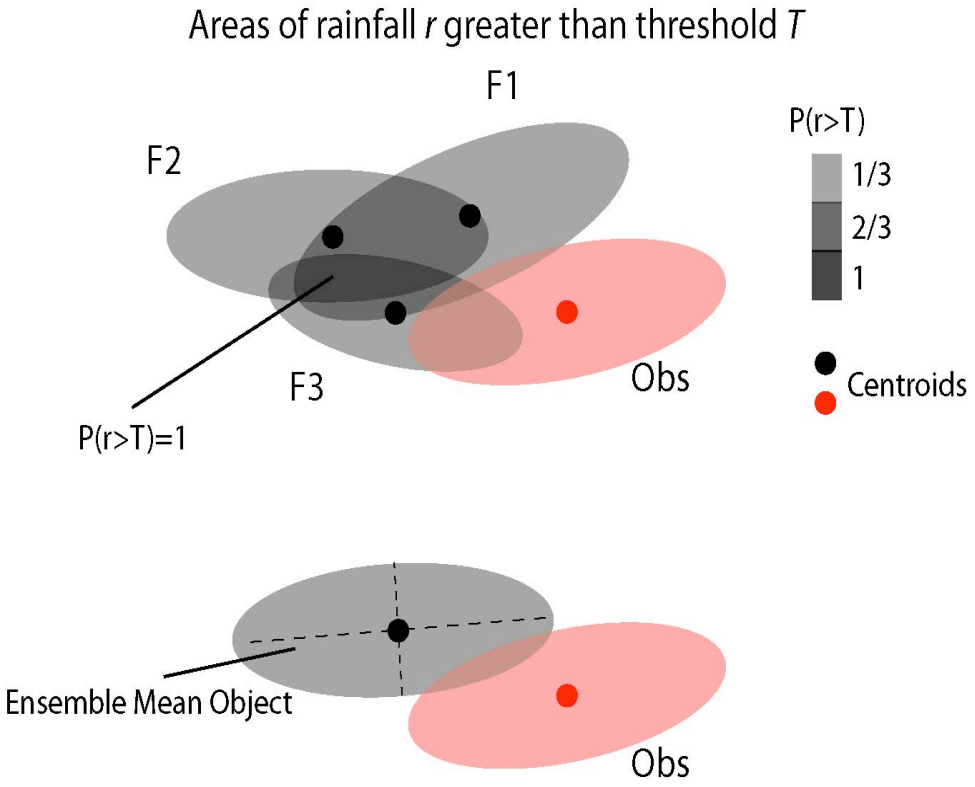
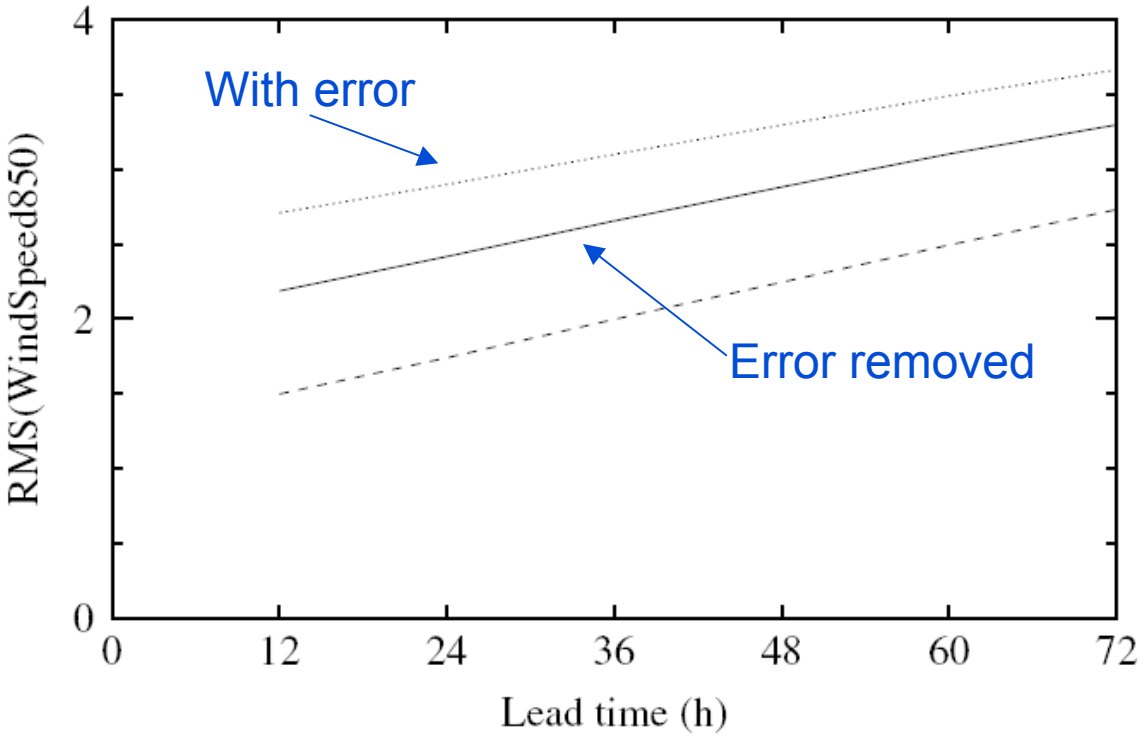


Fig from C. Davis

Impacts of obs uncertainty on verification

- Observations are subject to errors (biases, representativeness, instrument, precision, etc.)
- Analyses combine information in different ways
  - And they incorporate various kinds of errors (obs, boundary, interpolation) that *may not be accounted for*
- What is the impact of this uncertainty on verification scores? How should this uncertainty be represented in verification?

Obs uncertainty leads to under-estimation of forecast performance

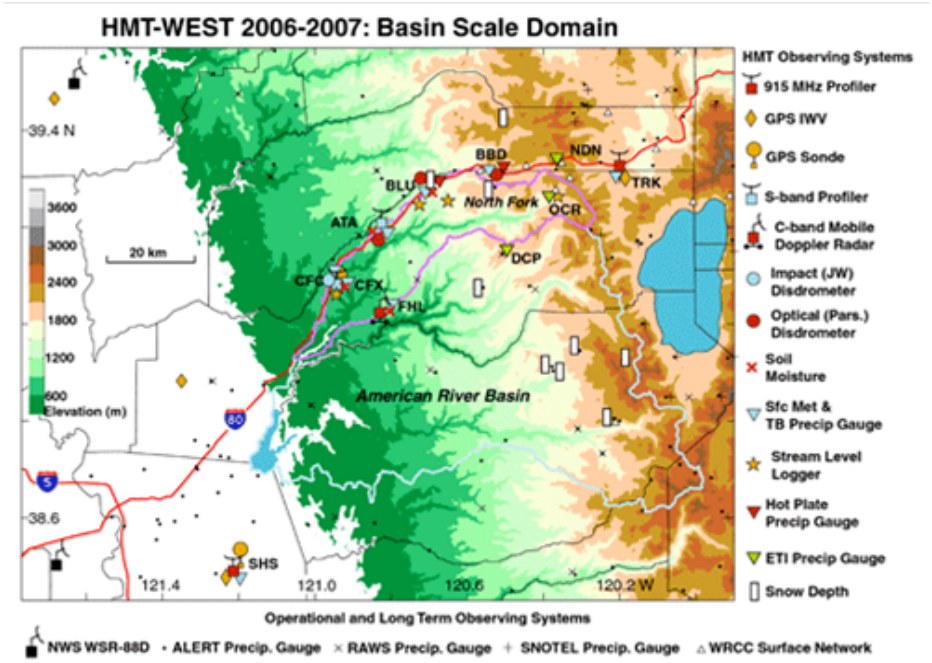


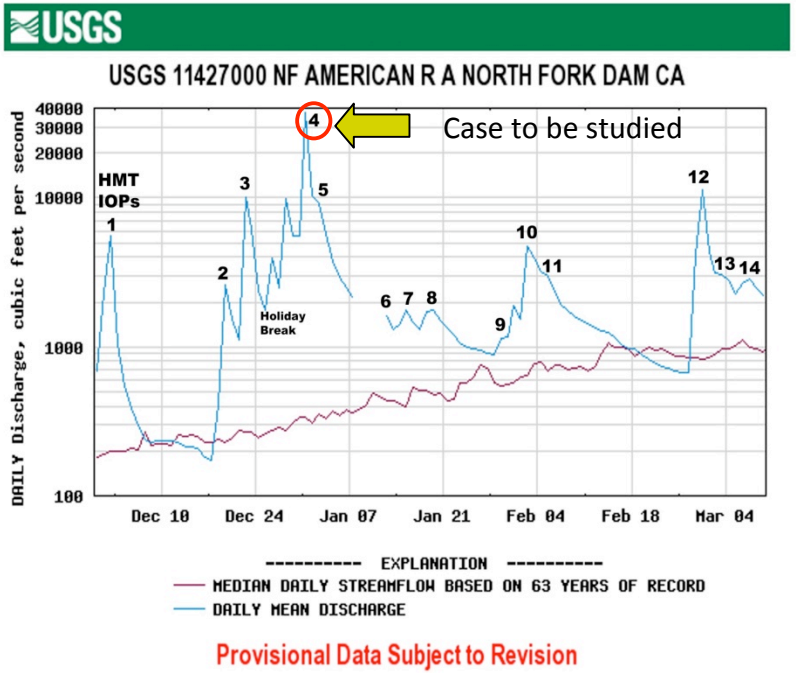
850 mb Wind speed forecasts

Assumed error = 1.6 ms^{-1}

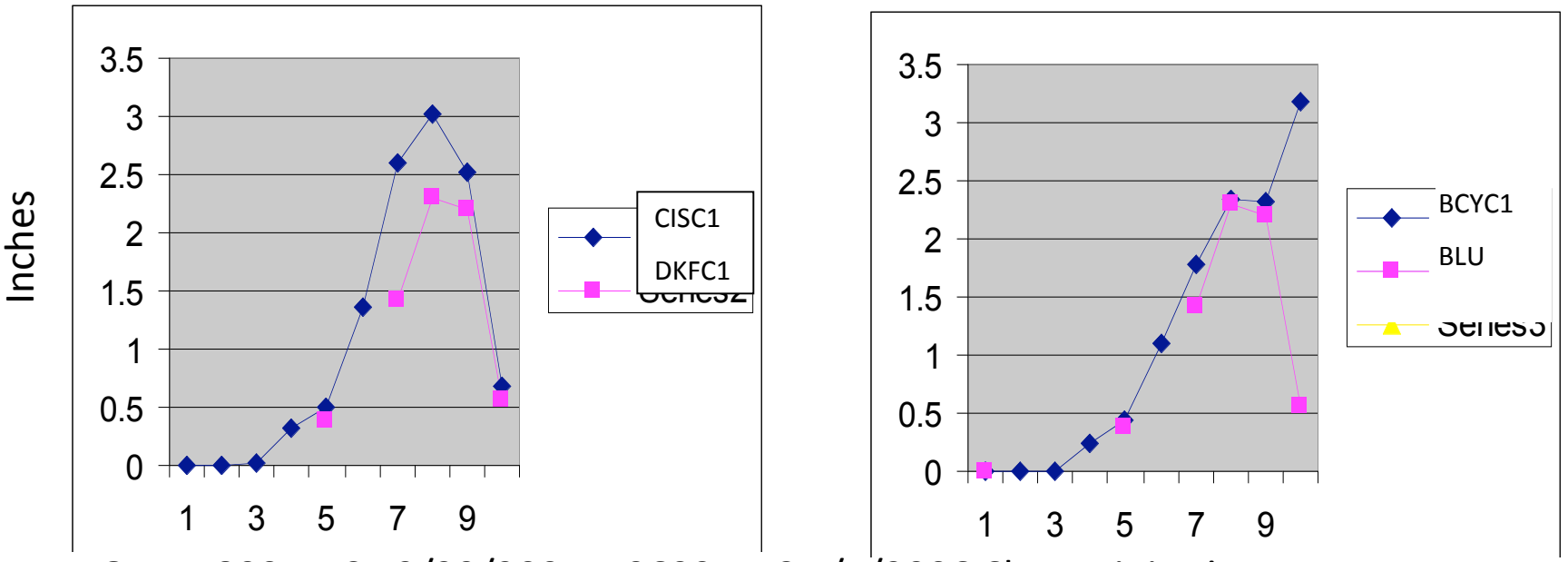
From Bowler 2008 (Met. Apps)

Observation uncertainty





Obs uncertainty: Adjacent gages…

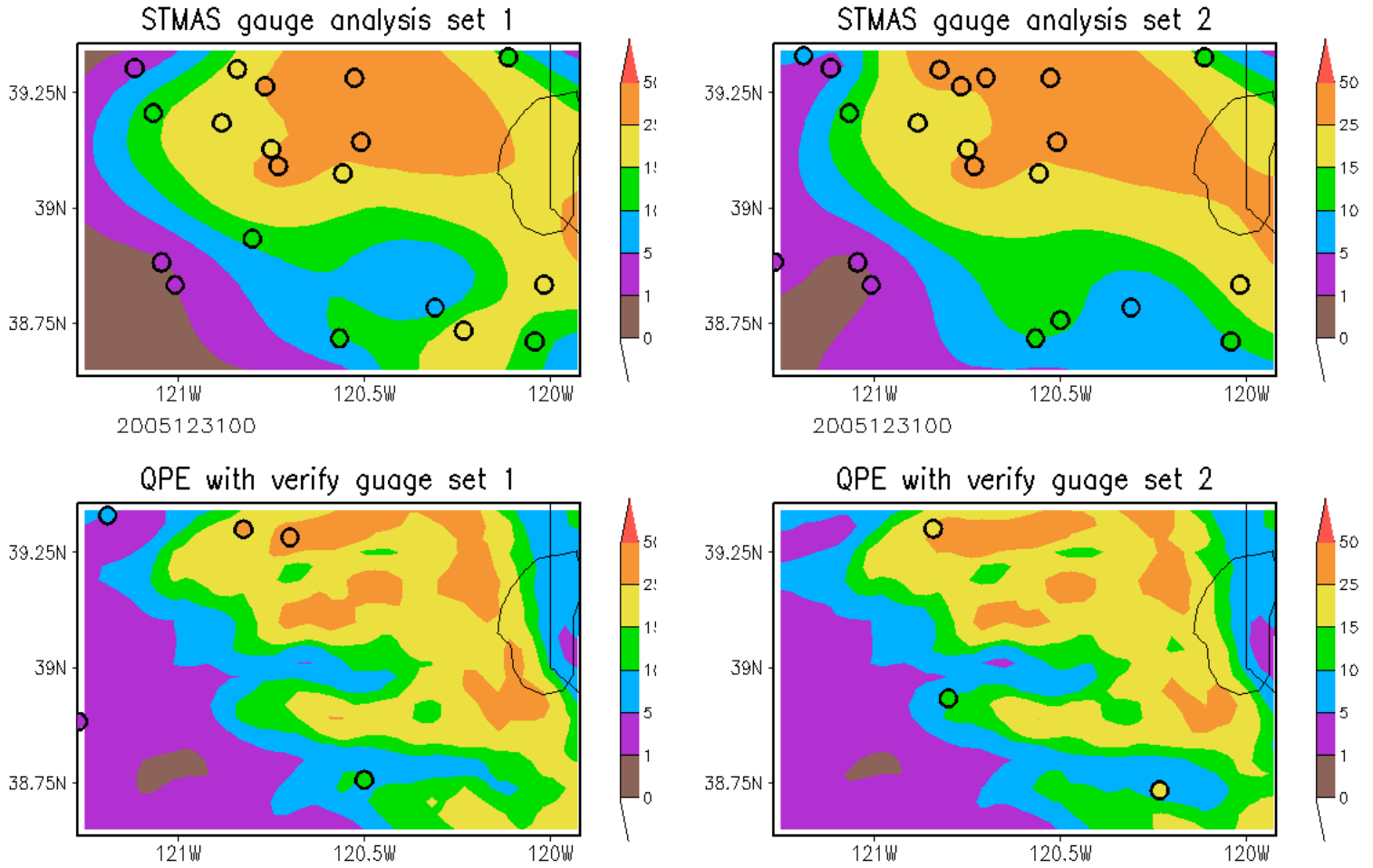


IOP 4 1800 UTC 12/29/2005 – 0600 UTC 1/1/2006 6h precipitation

From GSD DDRF Project Seminar March 27, 2008

Similar uncertainties exist with other types of measurements – such as radar, satellite, multi-sensor analyses

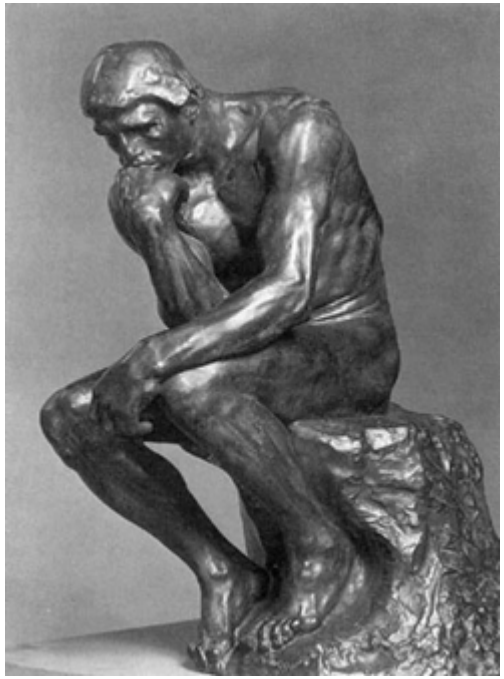
Impacts of obs uncertainty and variability



6h Precipitation Ending 0000 UTC 31 December 2005

Impacts of obs uncertainty on verification

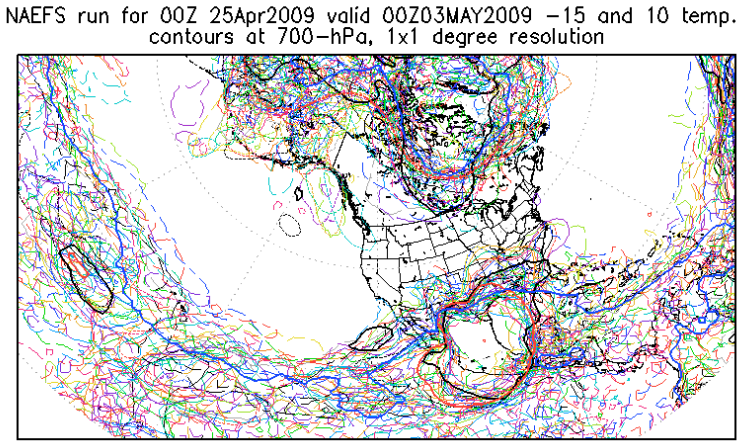
- Allow efficient application of multiple analyses
  - Comparison of verification results
  - Comparison of analyses
- Investigate impacts of observation variability and uncertainty on verification results
- Goal: Methods to incorporate obs uncertainty (as we currently incorporate sampling uncertainty)

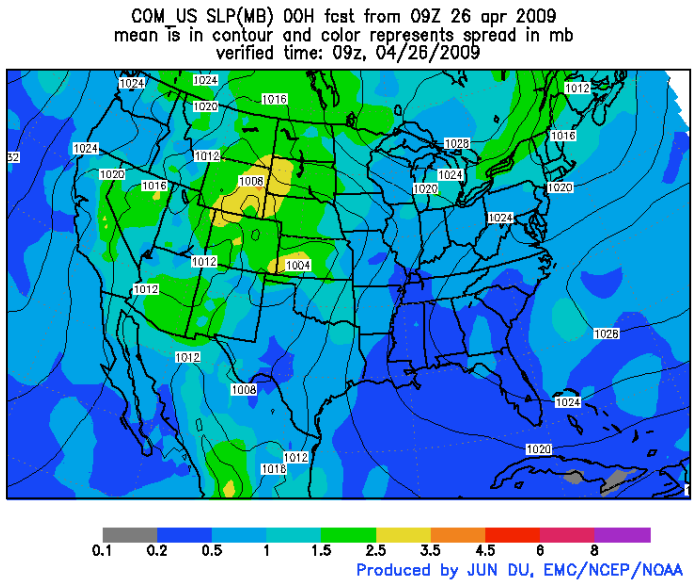


Trying to find the "truth"…

Area 2: Ensemble forecasting

- DTC goal:
  - Develop capability in ensemble forecasting
  - But – What does that mean?
    - Post-processing and bias correction tools?
    - Generation of ensembles?
    - Testing and evaluation framework?
    - Other?

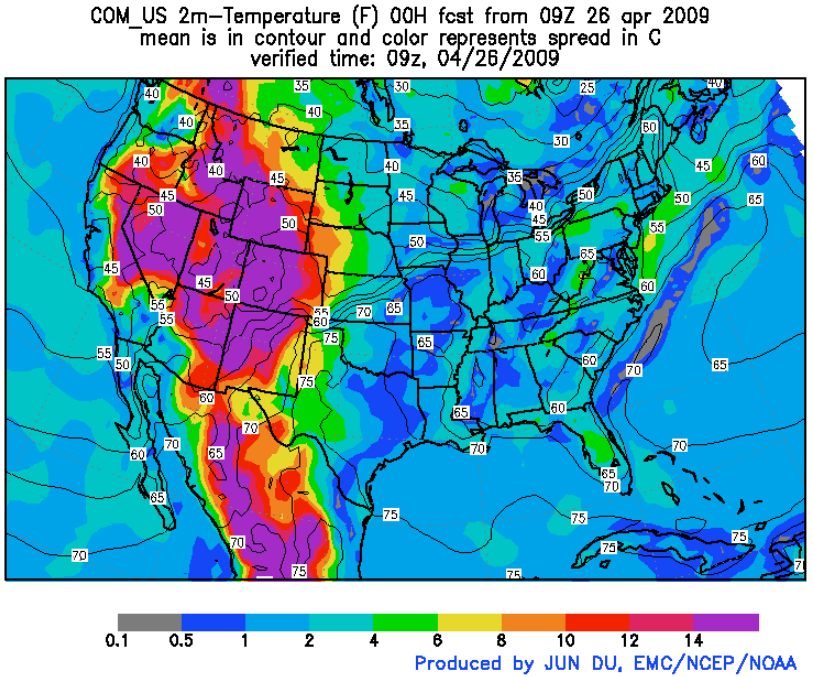




Area 2: Ensemble forecasting

Initial DTC/HMT collaboration

- Establish working group
- Workshop on community needs
  - Focus on high-res hydrometeorological forecasts
  - Include ensemble experts, operational centers
  - Identify goals and steps to taken
- Implement initial steps



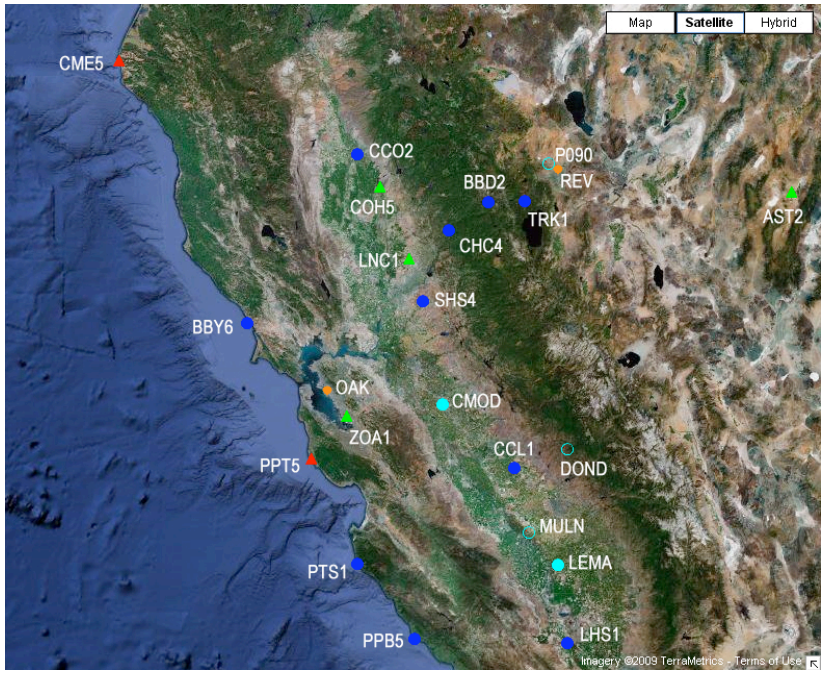
Area 3: Data impact studies

Long-term goal:

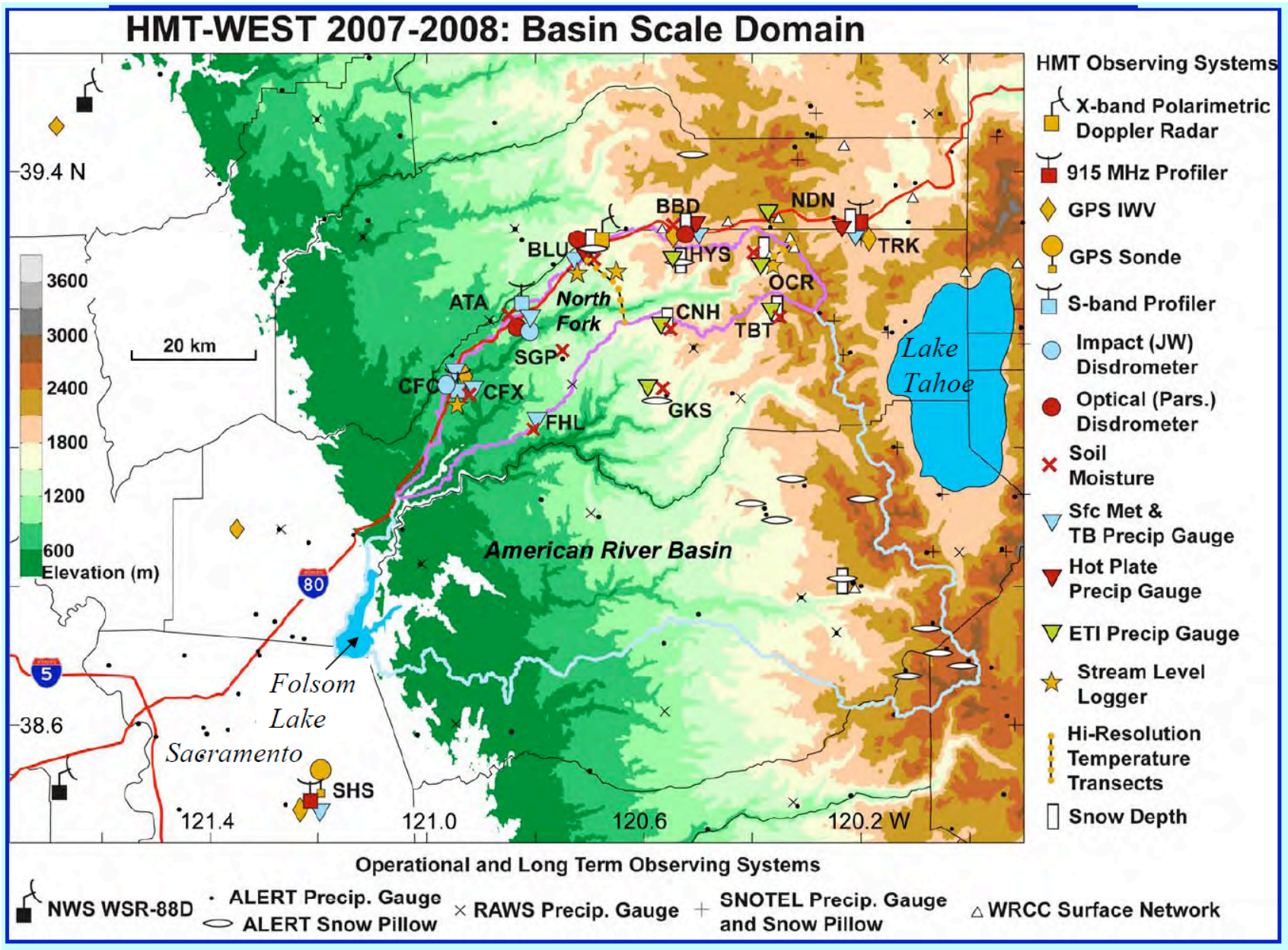
Investigate impacts of new and existing observations on NWP predictions of high-impact weather

- Make use of HMT high-density and new observations
  - Ex: Ground-based GPS water vapor, Space-based radio occultation data impacts on QPF
- Focus on HMT high-impact weather categories
- Impacts on prediction and verification

GPS Met sites



From S. Gutman

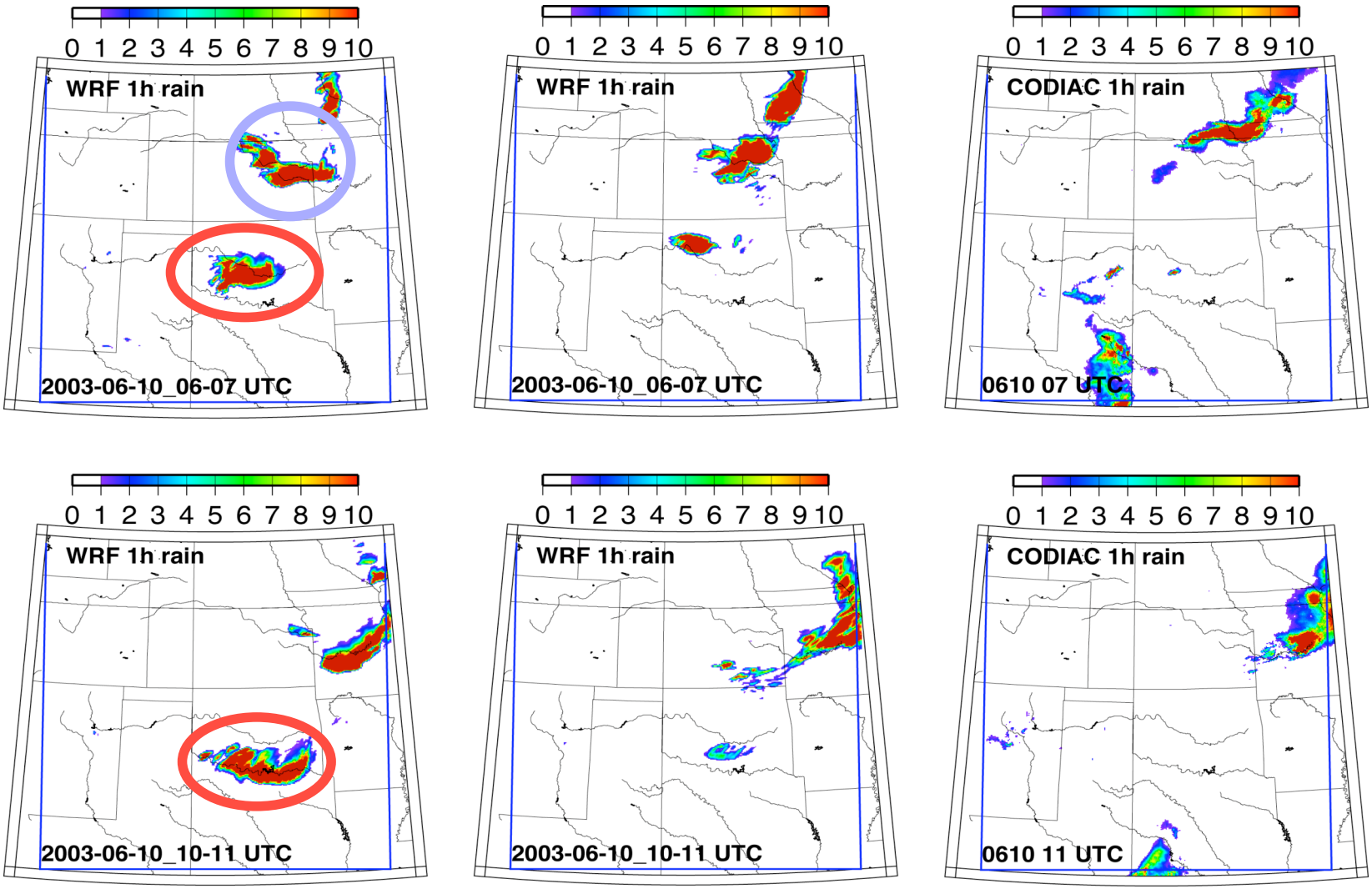

HMT-WEST 2007-2008: Basin Scale Domain
39.4 N
38.6
121.4
121.0
120.6
120.2 W
20 km
3600
3000
2400
1800
1200
600
Elevation (m)
BBD
NDN
TRK
HYS
BLU
OCR
ATA
North Fork
CNH
TBT
SGP
CFC
CFX
GKS
FHL
Lake Tahoe
American River Basin
Folsom Lake
Sacramento
SHS
80
5
HMT Observing Systems
X-band Polarimetric Doppler Radar
915 MHz Profiler
GPS IWV
GPS Sonde
S-band Profiler
Impact (JW) Disdrometer
Optical (Pars.) Disdrometer
Soil Moisture
Sfc Met & TB Precip Gauge
Hot Plate Precip Gauge
ETI Precip Gauge
Stream Level Logger
Hi-Resolution Temperature Transects
Snow Depth
Operational and Long Term Observing Systems
NWS WSR-88D
ALERT Precip. Gauge
ALERT Snow Pillow
RAWS Precip. Gauge
SNOTEL Precip. Gauge and Snow Pillow
WRCC Surface Network

BAMEX Data Assimilation

Control

Cycling GPS+WP

Obs.



From COSMIC/UCAR

Comparison of QPF bias for forecasts with ("non-local") and without ("control") COSMIC data

* Numerical values represent difference between the two forecasts in inches, normalized by the total observed precipitation at that site. It is expressed as a percentage.

*Color fill represents which forecast had smallest bias:

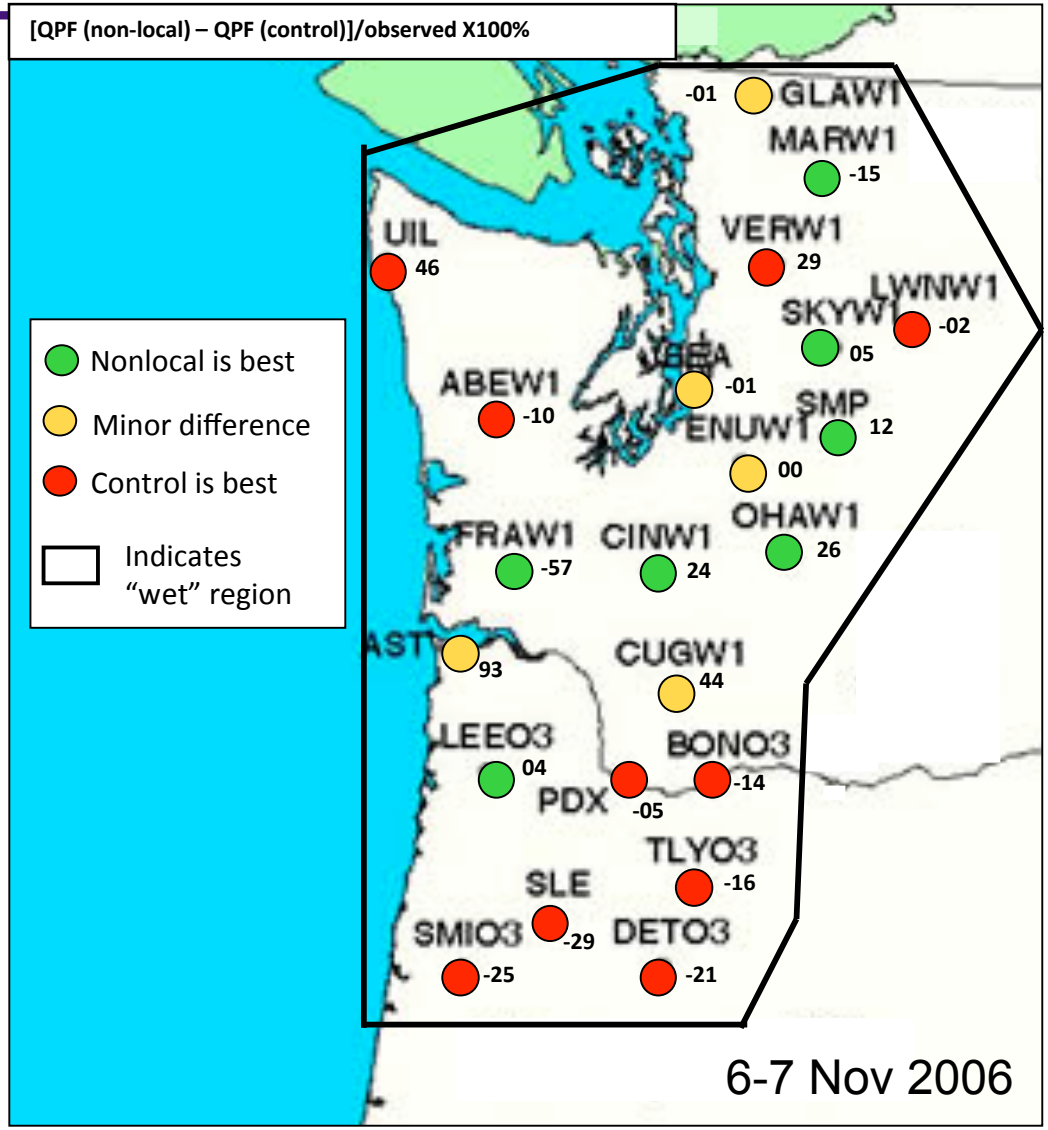
-green: COSMIC data improved the forecast

-red: Control run without COSMIC is still best

-yellow: Differences were minor

*****The COSMIC data improved the QPF at sites where the heaviest rain fell.**

NOLOCAL performs better than LOCAL.



From Ma et al. seminar

Data impact studies

Initial steps:

- Establish HMT/DTC focus group
- Outline initial goals and scope of testing activity
  - Will include software packages DTC supports to the community (GSI, WPS, WRF, WPP, and MET)

Area 4: Impacts of model physics and parameterizations

Long-term goal:

Investigate impacts of model parameterizations and physics packages on WRF model predictions of hydrometeorological variables in HMT focus regions

- Make use of HMT regular and special observations

Initial steps:

- Form an HMT/DTC focus group to carefully define testing activities
- Identify specific DTC testing activities

HMT/DTC Collaboration - Summary

- DTC and HMT have many common interests, and capabilities that can be beneficial to both
  - Exciting opportunities for progress in several areas
- Collaboration will focus initially on
  - Verification implementation and demonstration of verification capabilities
  - Development of DTC capabilities in ensemble forecasting
- Later activities will include
  - Data impact studies
  - Investigating impacts of model physics and parameterizations
- Many of these topics and interests cross over to other testbeds – many additional opportunities for collaboration